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REMAINING MEDIA LENGTH ESTIMATION AND FILTERING ALGORITHM

HP INC

Remaining media length estimation and filtering algorithm

Abstract

The proposed algorithm allows the printer to estimate the remaining media and thus, the printer, could inform of it allowing the customer to check if their job fits on the loaded roll or calculate how many copies they can do among other things.

The presented disclosure's algorithm to estimate the remaining media length in the loaded roll without adding any new sensor more than the currently present in our printers. This allows to deploy the solution via firmware update to all our printers.

The solution estimates the remaining length of the loaded media roll without the need if tracking it using a barcode or reference on the media. Then the customer could recall the estimated remaining media at any moment after loading the roll to perform his job in a more efficient way.

Problems Solved

Currently customer have a limited roll remaining media length tracking functionality in our printers. Some of them offers the possibility of print a barcode to track the roll media usage but implies a media waste.

Not knowing the remaining media creates an overhead to customer as they are not able to print some jobs near the end of roll as maybe out of media before it finish or increase the media saving being sure that the job fits the remaining media.

Prior Solutions

Most of our products do not offer the possibility to inform users about the remaining media length of the loaded roll. Customers need to make a self-estimation on how much media left in the roll before start to print on it.

DesignJet products offers the possibility to print a barcode during the unloading to write how track how many meters have the media roll. This solution is suboptimal as implies a media waste, longer load/unload workflows, and if for some reason the roll is manipulated, and the barcode lose, the tracking cannot be done.

Description

Our printers have encoders that provides position information in the Media Drive Roller and Media Input Motor. These sensors are mean to control both the Media Advance and Media Input during media movement. Currently the media roll diameter (r_{roll})is estimated using both sensors information as part of the Media Input algorithm. This radius is estimated as:

$$\frac{d}{d\theta} l = r_{roll}$$

Where *l* is the media linear movement reported by the Media Drive Roller encoder and ϑ is the angular movement of the Media Input roll.

Knowing the roll diameter allows an estimation of the remaining media (l_{roll}) using the expression

$$l_{roll} = \frac{2\pi \int_{r_{core}}^{r_{roll}} r\,dr}{thickness}$$

where r_{core} is the roll's core radius and *thickness* is the thickness of the media. This expresion could be simplied in:

$$l_{roll} = \frac{2\pi \left(\frac{r_{roll}^2}{2} - \frac{r_{core}^2}{2} \right)}{thickness}$$

Roll's core radius and thickness are media dependent and could be obtained in multiple ways:

- **User input**: the user could input the thickness and core radius during loading process. Although is the simpler implementation is the less user-friendly.
- **Lookup table**: media thickness and core radius are obtained from a lookup table were the information is stored for each media type. Values are recalled during loading when the user select the loaded media and could be modified by the user to fine tune the estimation.
- **Thickness estimation**: thickness could be estimated as the derivate of the roll radius respect rotation. However, as it is the second derivate of the advance with respect media roll's angular movement it requires to be heavily filtered to reduce noise in the estimation.

$$thickness = 2\pi \left(\frac{d}{d\theta} r_{roll} \right)$$

As roll radius is a noisy measure, to improve the estimation estability the following filtering algorithm is proposed where the new estimation is done weighting

- the estimation based on media roll radius lroll_radius described previously that could be noisy but reliable in the long term
- the estimation reducing the remaing length from the previous update (l_{roll_prev}) by the advance media which is an estable but not reliable in the long term indirect measure.

$$l_{roll} = \alpha \ (l_{roll\_prev} - l_{adv}) + (1-\alpha) \ l_{roll\_core}$$

In the expresion α will be the wight factor and have a value between 0 and 1 being a value around 0.95 the recommneded as allows to take advantage of the properties of both estimations.

Advantages

With this functionality the customer will be able to print all the jobs without spending too much time on understand if the job fit with the media roll that they want to use.

The solution will improve customer satisfaction by providing an estimation of the remaining media in the roll in several ways:

- Low time expend to understand the roll capacity.
- Higher confidence on make the jobs at time.
- Improves the efficiency of the jobs, as the customer can fit the full roll of images, without waste.

Moreover, the proposed implementation has the following advantages:

- Could be implemented in all our printers via FW update
- No extra sensors are required
- Thickness and roll's core radius values for each media could be easily stored in a lookup table.

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